

DOCUMENT RESUME

ED 091 414

TM 003 626

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TITLE Magnitude Estimation Scaling in Needs Assessment.
SPONS AGENCY Stanford Research Inst., Menlo Park, Calif.
PUB DATE [74]
NOTE 29p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, Illinois, April, 1974)

EDRS PRICE MF-\$0.75 HC-\$1.85 PLUS POSTAGE
DESCRIPTORS *Educational Assessment; *Educational Needs;
*Educational Objectives; Elementary Education;
*Measurement Techniques; *Multidimensional Scaling;
Parent Role; Statistical Analysis

ABSTRACT

The purpose of this study was to develop and field test a needs assessment procedure based on magnitude estimation scaling. The goal was to provide ratio scale expressions of the relative importance of school objectives by pertinent subsets and the total sample of school patrons. A patron-assembled set of 40 goals was evaluated by 132 fathers and 173 mothers of students and 15 faculty members from the participating school. The results verified the strength of the procedure. Proportional relationships (judged evaluation by patrons) between goals were developed for the total sample and sample subgroups. (Author)

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Magnitude Estimation Scaling
in Needs Assessment

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ED 091414

TM 003 626

The intent of this paper is to present a scaling technique known as magnitude estimation scaling and illustrate its use in needs assessment studies. This work was done at and supported by Stanford Research Institute. It was based on earlier work at the Institute conducted by Dr. Ter Meeland. A limited number of copies of the full report of this project are still available and can be obtained by contacting Dr. Philip Sorensen, SKI, 333 Ravenswood, Menlo Park, California 94025. Ask for Patron Assessment of School Objectives for M___ School, July 13, 1973.

Currently, there is little utilization of this scaling technique in educational research. However, since the 1940's, considerable effort has been expended in the area of psychophysical research to develop scales involving the various senses. Most noteworthy previous work was the development of the decibel scale in the area of hearing.¹ Recently, arguments claim that the procedures used in psychophysics,² including cross-modality matching, show a remarkable consistency when applied to such diverse phenomena as preferences for watches,³ occupations,⁴ odors,⁵ the importance of monarchs,⁶ the degree of frustration and aggression in a military setting,⁷ and the scaling of seriousness of delinquent offenses.⁸

The essence of magnitude scaling is contained in the proportionality that is judged to exist among the various items under consideration. Whereas category (or confusion) scaling

requires the assignment of an item to one of several categories (7, 9, or 11, typically) assumed to be spaced equally along a continuum when in fact they are not, magnitude estimation scaling requires the assessment of the amount above or below the standard that an attribute of an item has. Naturally, the standard (or reference) item and other items are presented in random order to avoid any systematic influence on the outcomes. Furthermore, item weights are computed on the basis of geometric, not arithmetic, means since it has been observed that the variability of magnitude estimations tends to increase in proportion to the magnitude and that the distributions are log normal.² If magnitude estimation scaling results are compared with category scaling, a curvilinear relationship is observed which vanishes when log-log coordinates are used, indicating the presence of a power function.

Other than for psychophysics, the most extensive use of magnitude estimation scaling occurred in a three year study of crimes reported by Sellin and Wolfgang in which the judged seriousness of crimes was established and additive weights for various crimes were developed.⁸ Recently, the technique of magnitude estimation scaling was applied by Meeland and Kaplan in the realm of insurgency to define the judged seriousness of terrorist-initiated acts of violence and the importance of the counter-insurgents' suppression activities.⁹

In spring 1973, SRI queried the several State Departments of Education asking for instruments and guidelines used in needs

assessment and schools involved in needs assessment programs. Responses from nearly forty states and several cities within these states were received by mid-April, 1973. A perusal of the responses indicates that development of tools and procedures lags the demand for these procedures. There is a need for procedures based on a uniform core of educational objectives which provide information for all decision levels within a defined area and yet which maintain some flexibility so that each school can secure adequate information suited to the local needs.

In an effort to develop such procedures, SRI cooperated with administrative faculty and parents at M___ school in a needs assessment study. M___ school is a primary school consisting of grades K through third.

SRI provided a committee of faculty and parents with a set of statements of educational objectives that were designed for elementary school. The committee was free to alter this list in any manner that it so desired. Since the third grade is the top grade in this school, the committee chose to make several changes by deleting some objectives, rewriting most of the others so that they were appropriate for the limited grade range of the school, and adding other objectives as they saw fit. SRI made a limited number of editorial changes in the statements of objectives to make them more behavioral in nature and consistent in style. Care was taken so as not to change the intent of the objectives. The final statement of objectives as produced was

submitted to and approved by the committee.

The following is an outline of the objectives covered:

I. Reading

1. Appreciation
2. Skill
3. Understanding

II. Mathematics

1. Skill
2. Utilization

III. Language Arts

1. Usage
2. Listening Skills
3. Speaking Skills
4. Writing Skills
5. Study Skills

IV. Affective

1. School Attitude
2. Self Concept
3. Outside Interests
4. Achievement Motivation
5. Personal Temperament
6. Attitude, Social
7. Attitude, Ethnic

V. Health Physical Education

1. Health, Safety

2. Physical Education

3. Sportsmanship

VI. Cognitive

1. Knowledge

2. Understanding

3. Application

4. Problem Solving

5. Creativity

6. Judgment

VII. Science

1. Earth Science

2. Biology

3. Biology, Drugs

4. Physical Science

VIII. Social Studies

1. Family Life

2. Anthropology

3. Ecology

4. Economics

5. Geography

6. History

7. Employment

IX. Art

X. Music

XI. Foreign Language

The major groupings of these objectives and the one or two word identifier associated with each objective were provided by SRI after the data for this report were collected. This was done to facilitate data reduction and reporting, and could not influence the respondents' reactions to the objective.

The style in presenting each objective is illustrated by the objective for reading appreciation.

UPON COMPLETION OF M SCHOOL (3RD GRADE), IT IS DESIRABLE THAT AS A RESULT OF SCHOOL MOST CHILDREN

Have an appreciation for reading.

Examples (they do at least some of the following):

Select reading materials to read for enjoyment.

Select reading materials for study.

Use reading as a way to solve a problem.

Read in order to learn how to do something new.

Read to learn about current events.

The final instrument included a cover statement from the principal, directions for rating the objectives, and a brief one page questionnaire. One unique aspect of this instrument was that the listing and printing of the objectives was done under computer control. For each printing, the order of the objectives was randomized. In all probability, no two parents in the population received the objectives in the same order. This procedure also randomizes the reference items since the first item in the list is the reference item for each respondent.

The materials were assembled with enough materials for two respondents in each package. One package was sent home with the oldest child from each family. Consequently, all third grade

students took home one packet. All other students in grades kindergarten through second, took home one packet only if they did not have an older sibling in the same school (e.g., if a family had a child in kindergarten and one in second grade, the second grade child took a packet home but the kindergarten child did not). The committee had decided that respondents should not be identified so individual form numbers were not recorded. Form numbers, by classrooms in which the packets were passed out, were recorded. Consequently, each respondent could be associated with the grade level containing the oldest child from a given family.

In the scaling procedure known as magnitude estimation scaling, the concern was not with the absolute value or ranked position assigned each objective by the respondent, but was with the ratio of the distances between the ratings of each objective by each respondent.

Each respondent assigned a value to each objective by comparing each objective to a randomly selected reference objective which was assigned a value. For example, the randomly assigned objective, V-2 Physical Education, had an assigned value of fifty. The respondent compared all other objectives to this one. If a given objective was judged twice as important by the respondent, he assigned it a value of one hundred. If he judged it was one half as important, he assigned a value of twenty-five. If the respondent thought reading skills, objective I-2, was three times as important,

he assigned the value of one hundred fifty to that objective.

It was desirable that the reference objective was randomly selected for each respondent. It did not matter if the same value was assigned to each referent, however, in this study a value of fifty was assigned to each. It was essential that the respondent express the relative importance of each objective as it related to the referent. The average of these relationships was best expressed by computing the geometric mean of the values assigned each objective by all respondents. These geometric means not only expressed the rank position of each objective but the relative distance between each objective. An objective with a geometric mean of 64 was judged to be twice as important as an objective with a geometric mean of 32.

Lack of time and funds have prevented us from doing all statistical procedures that are of interest to this project. For example, we do not report statistical significance of observed differences. Moreover, there is no attempt to interpret these findings as a sample of a larger population. This is, rather, a description of the responses of a total population defined as parents of children in M___ school who responded to this survey. Over 50% of available parents responded.

Apparent practical differences were important to those concerned with school policies and programs. These practical differences can be defined as differences that could influence school policy. Such differences can only be judged by policy

makers when all influencing factors are considered (i.e., budget, staff). Other differences were of interest but had little to do with policy. For example, female parents rated reading more than 50% higher than did male parents. Such knowledge may help in dealing with parents but may be of little value in curriculum planning. However, the fact that parents rated language arts 20% higher than did faculty may have significant implications.

The limitations of this paper do not permit presentation of the tabular data. However, some of the figures derived from these data will be presented for illustrative purposes.

Since the faculty was a small group (fifteen), it was not further subdivided. The parents comprised a much larger group of over three hundred respondents and was subdivided on variables such as sex, age, years of education or various perceptions about the educational scene.

A statistic labeled "Special Emphasis Value" was compiled. The first item on the questionnaire asked the respondent "...above what number do you consider the objectives so important that the objectives should be given special emphasis at M___ school?" The objective evaluation score was computed for this item. The companion item on the questionnaire seeking those items of little or no value is not indicated in this report. The values here were so low that in all cases, all objectives were above this point. Apparently all objectives have some value for M___ school.

It is known that the plot of the raw data collected from

the respondents is curvilinear in nature and that the logarithms of the responses is most nearly linear in nature. Therefore, the standard deviation of the logarithms was computed for each population category as the appropriate statistic to express spread or dispersion of the scores. The spread in the scores is related to the level of agreement among the members of a group. If all members of a group agree on a score placement, then the spread will be small. A low standard deviation indicates a high level of agreement among respondents and conversely, a high standard deviation indicates a relative lack of agreement among the respondents. The two groups of greatest interest to this report are faculty and parents total. For these two groups, the mean and the standard deviation of the agreement scores were computed with the following results:

	<u>Mean</u>	<u>S.D.</u>
Parents	.539	.090
Faculty	.451	.202

The difference between the two means was not statistically significant ($t=1.69$). We cannot conclude therefore, that the faculty were in closer overall agreement than were the parents on the evaluation of the full set of objectives.

Two types of figures were prepared from the data. In the first set, all objectives were displayed for major subsets of respondents. Figure I shows how all parents evaluated all objectives and figure II presents similar data for faculty.

In all figures, the mean for the objectives in each classification is indicated by a crossbar. The crossbar represents the

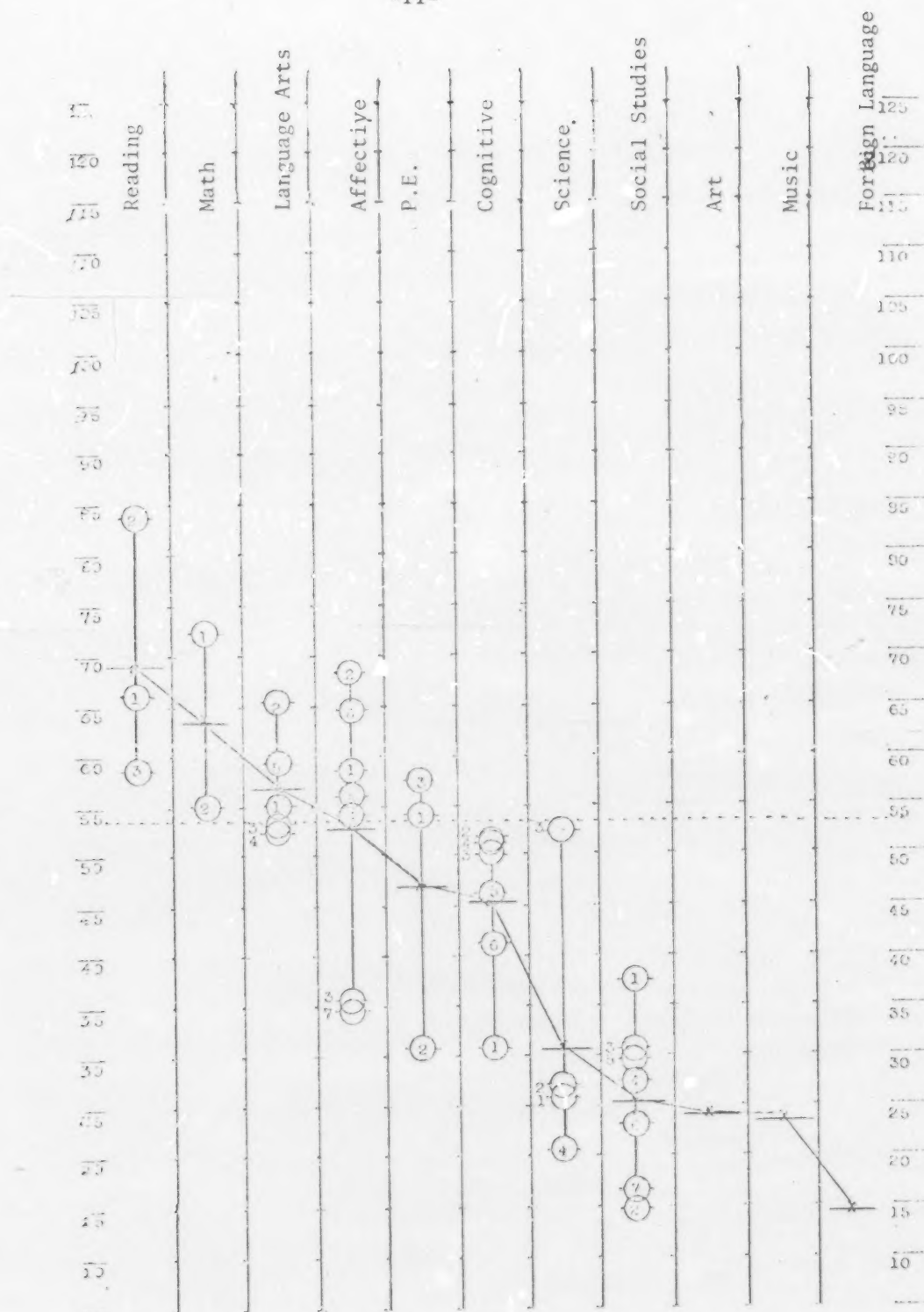


Figure 1 Objective Evaluation Scores
Parents Total Distribution

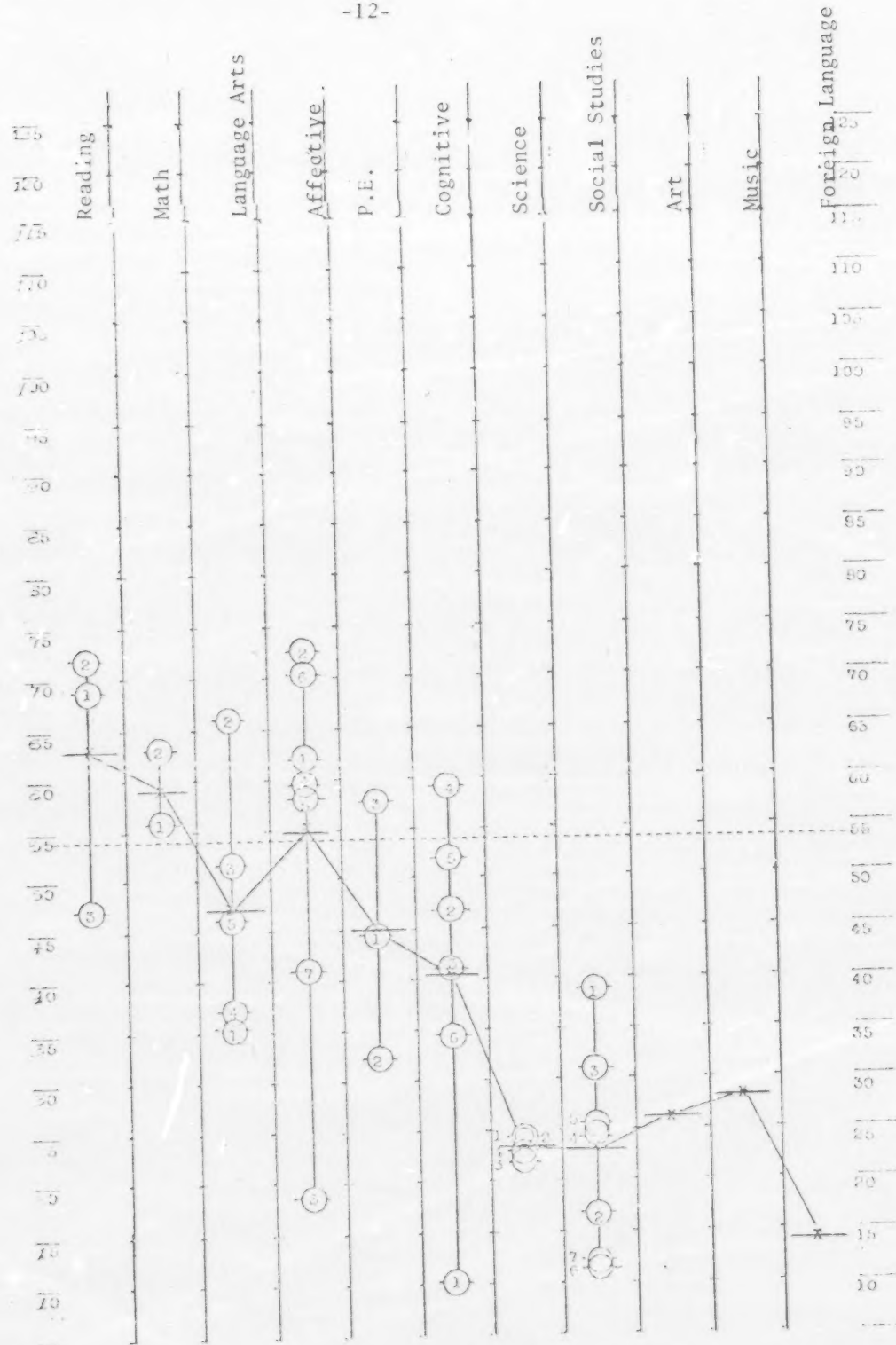


Figure II Objective Evaluation Scores
Faculty Total Distribution

value for the major heading. The objectives are grouped under the major headings and are keyed to the listing presented earlier. The major headings are arranged in descending order as evaluated by total parents. This order is preserved in other presentations. The broken line indicates the special emphasis value as determined by parents.

Figure I shows how total parents evaluated all forty objectives. Reading objectives are clearly the most important with reading skill being the highest ranked of all objectives. Mathematics objectives, as a group, rates a close second with mathematics skills ranking second only to reading skills. Language arts objectives, as a group, rates next. The third ranked single objective, however, is "self concept" in the affective group. Two of the objectives in the affective group, 3 (outside interests) and 7 (attitude, ethnic), are far below the others. Self concept is judged as nearly twice as important as either of these two. Except for these two low ranking objectives, the affective group would have ranked higher than the language arts group. The other major categories in descending order are: V Health--Physical Education, VI Cognitive, VII Science, VIII Social Studies, IX Art, X Music, and XI Foreign Language.

Several objectives are above the broken line. These were judged by the parents as deserving special attention and include the following:

- I. Reading
 1. Appreciation
 2. Skill
 3. Understanding
- II. Mathematics
 1. Skill
 2. Utilization
- III. Language Arts
 1. Usage
 2. Listening Skills
 3. Speaking Skills
 5. Study Skills
- IV. Affective
 1. School Attitude
 2. Self Concept
 4. Achievement Motivation
 5. Personal Temperament
 6. Attitude
- V. Health and Physical Education
 1. Health, Safety
 3. Sportsmanship

Figure 11 shows how the faculty responded to the total set of objectives. It is clear that although the pattern is similar to parents, there are some distinct deviations from the pattern resulting from parent responses.

The special emphasis value is nearly the same for faculty and

parents but the objectives included within this area are different.

The faculty would exclude from special emphasis:

Reading	#3 Understanding
Language Arts	#1 Usage
Language Arts	#5 Study Skills
Physical Education	#1 Health and Safety

The faculty would include Cognitive #5 (creativity) as deserving special attention.

The second type of figure demonstrates how particular sub groups respond to particular objectives. The responses to the reading objectives are presented here for illustrative purposes.

Figures III through IX show plots of objective evaluation scores for reading. Objective #2 (skill) ranks highest for all groups. For most all parent groups, the "skill" objective is considerably higher than the next ranking reading objective. For total parents, Reading #1 (appreciation) ranks more than 20% lower than Objective #2 (skill). Only the faculty (Fig. III) and parents who did not graduate from secondary school (Fig. V) rate appreciation nearly as high as skill.

Figure III shows that males rate reading more than one-third lower in evaluation score points than do females. In Figure IV, it will be noted that older parents place increased value on skill and appreciation but not on understanding. The young parents (those

Figure III READING OBJECTIVE EVALUATION SCORES

TOTAL PARENTS, FACULTY, PARENTS-MALE, PARENTS-FEMALE

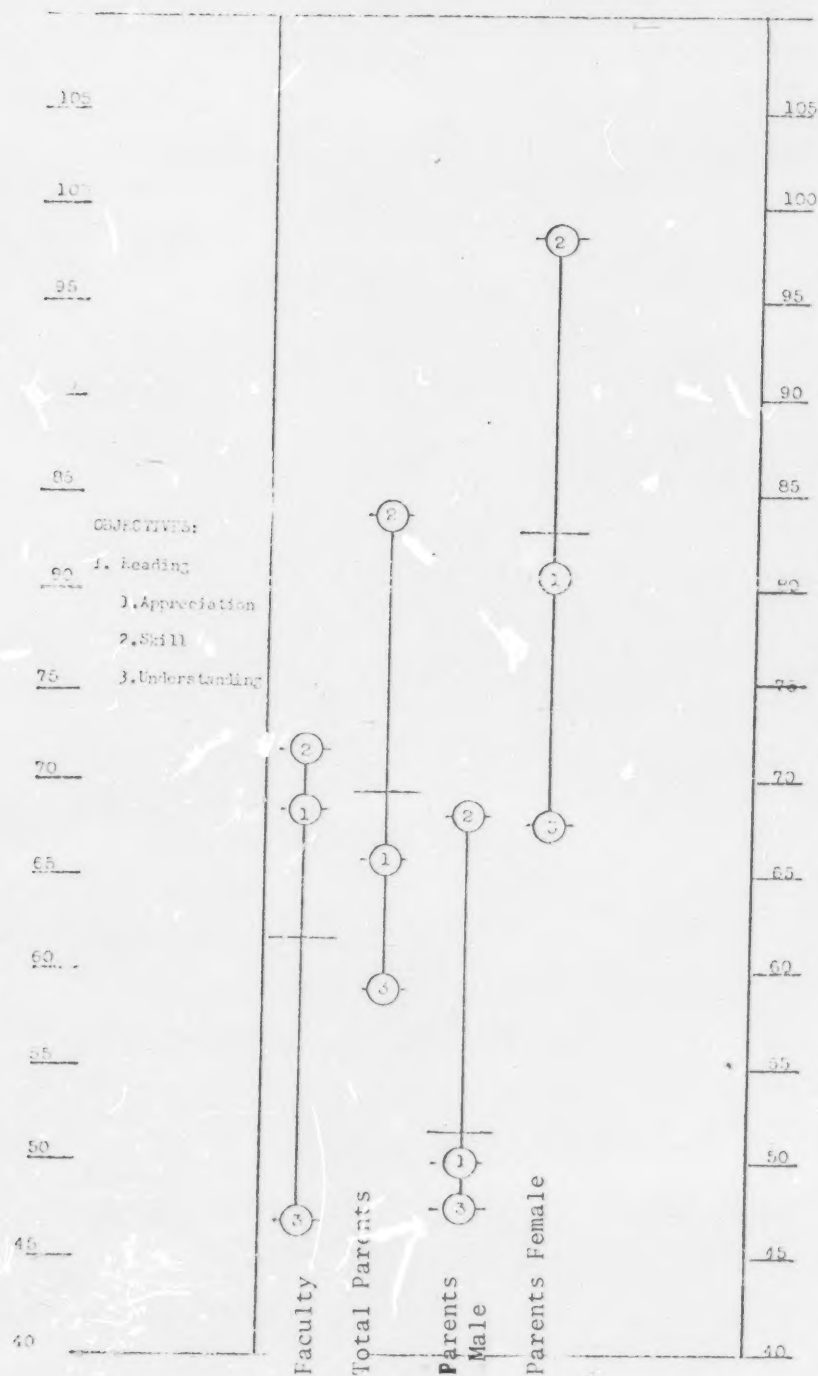


Figure IV READING OBJECTIVE EVALUATION SCORES
PARENTS BY AGE GROUP

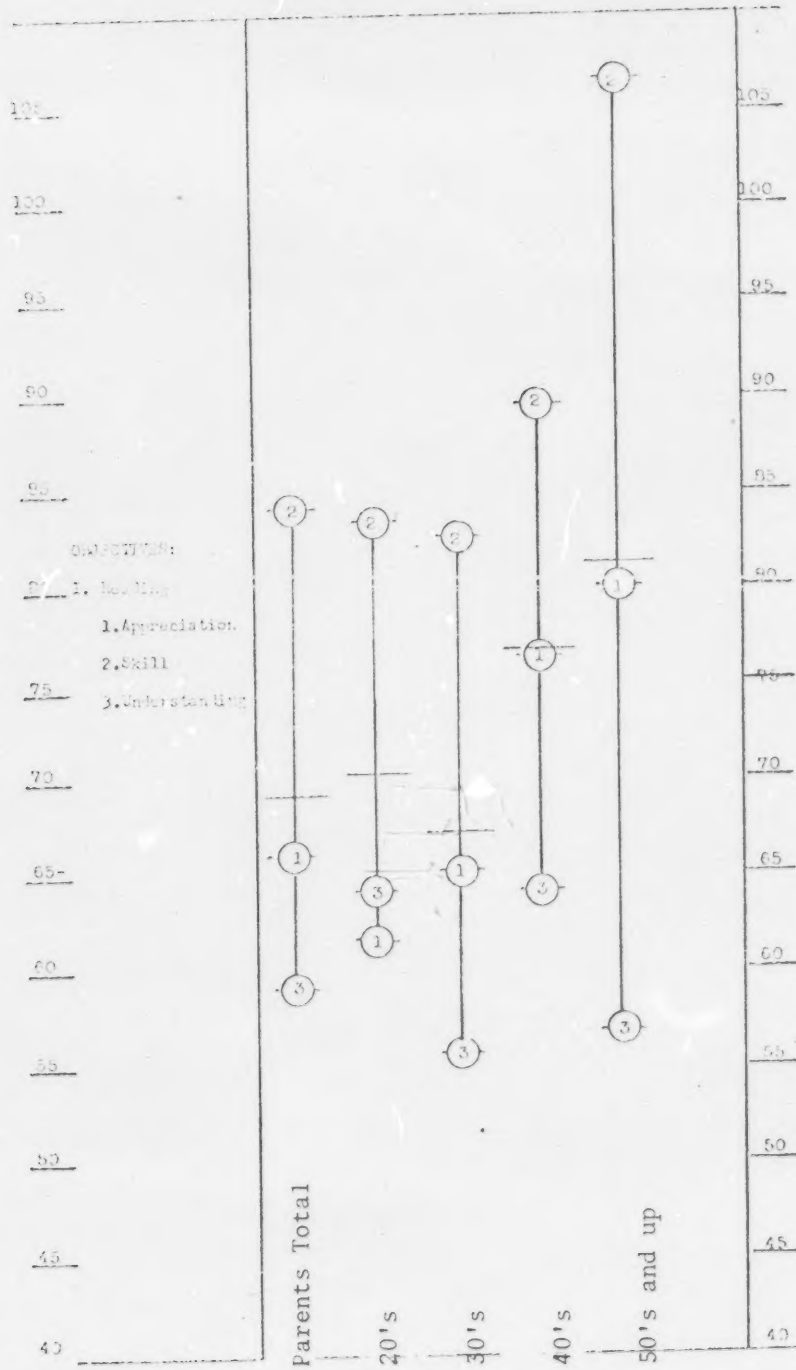


Figure V READING OBJECTIVE EVALUATION SCORES

PARENTS YEARS OF EDUCATION

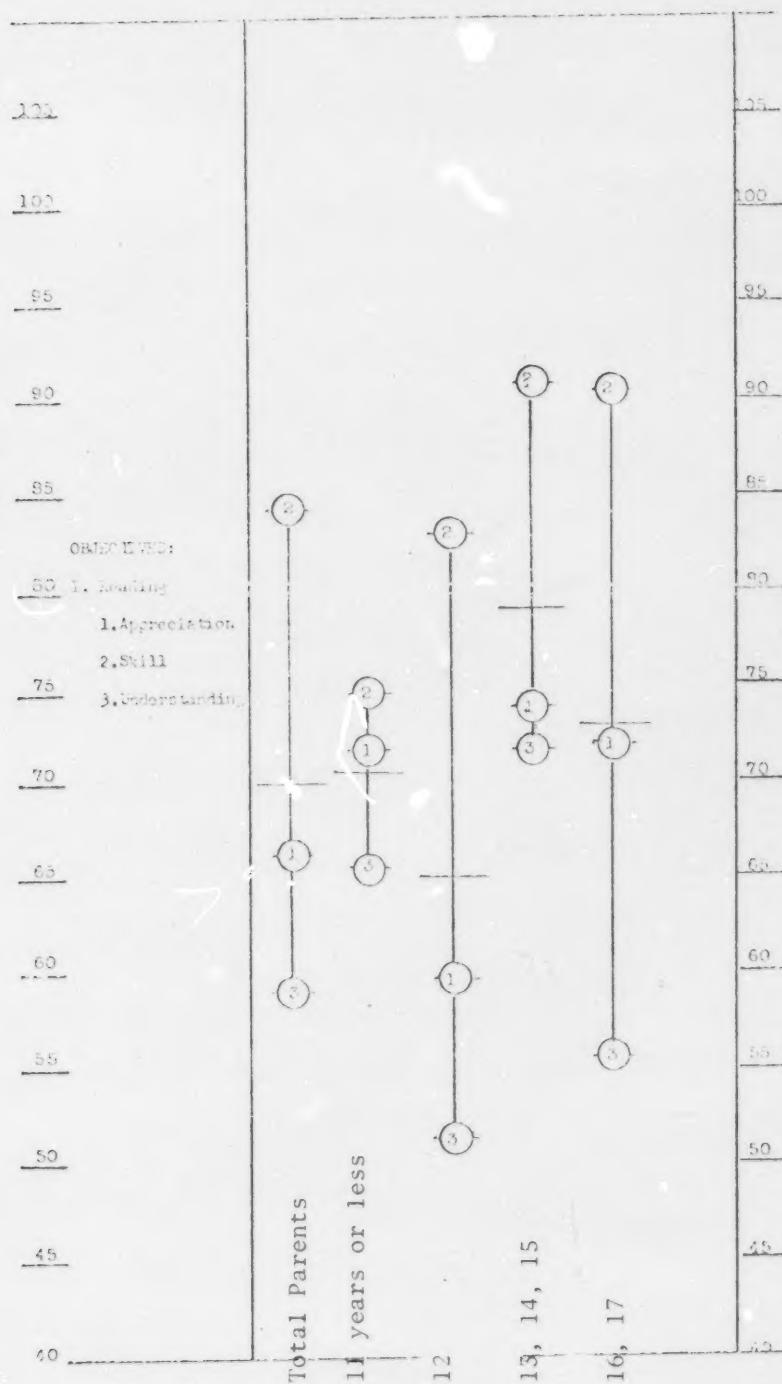


Figure VI READING OBJECTIVE EVALUATION SCORES
PARENTS BY FAMILY CONFIGURATION

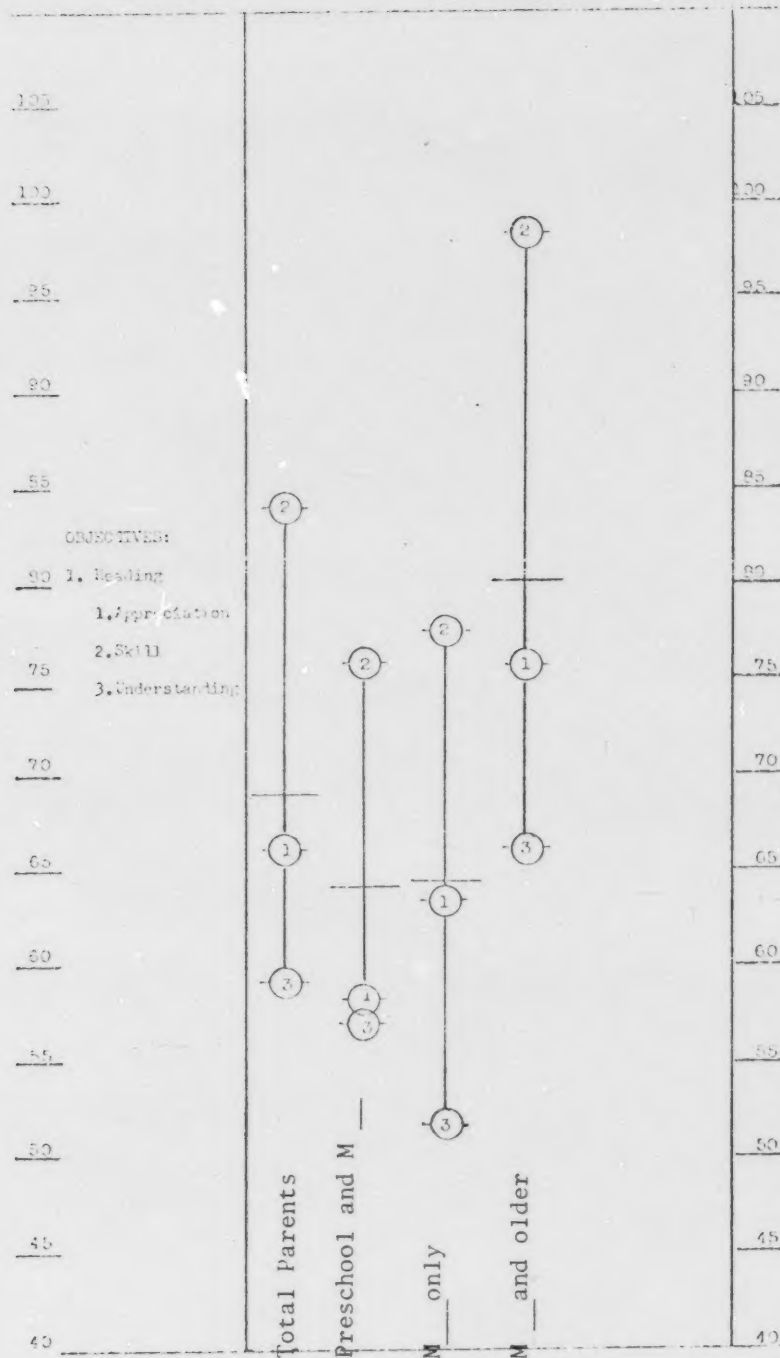


Figure VII READING OBJECTIVE EVALUATION SCORES
PARENTS ACTIVITY LEVEL IN SCHOOL AFFAIRS

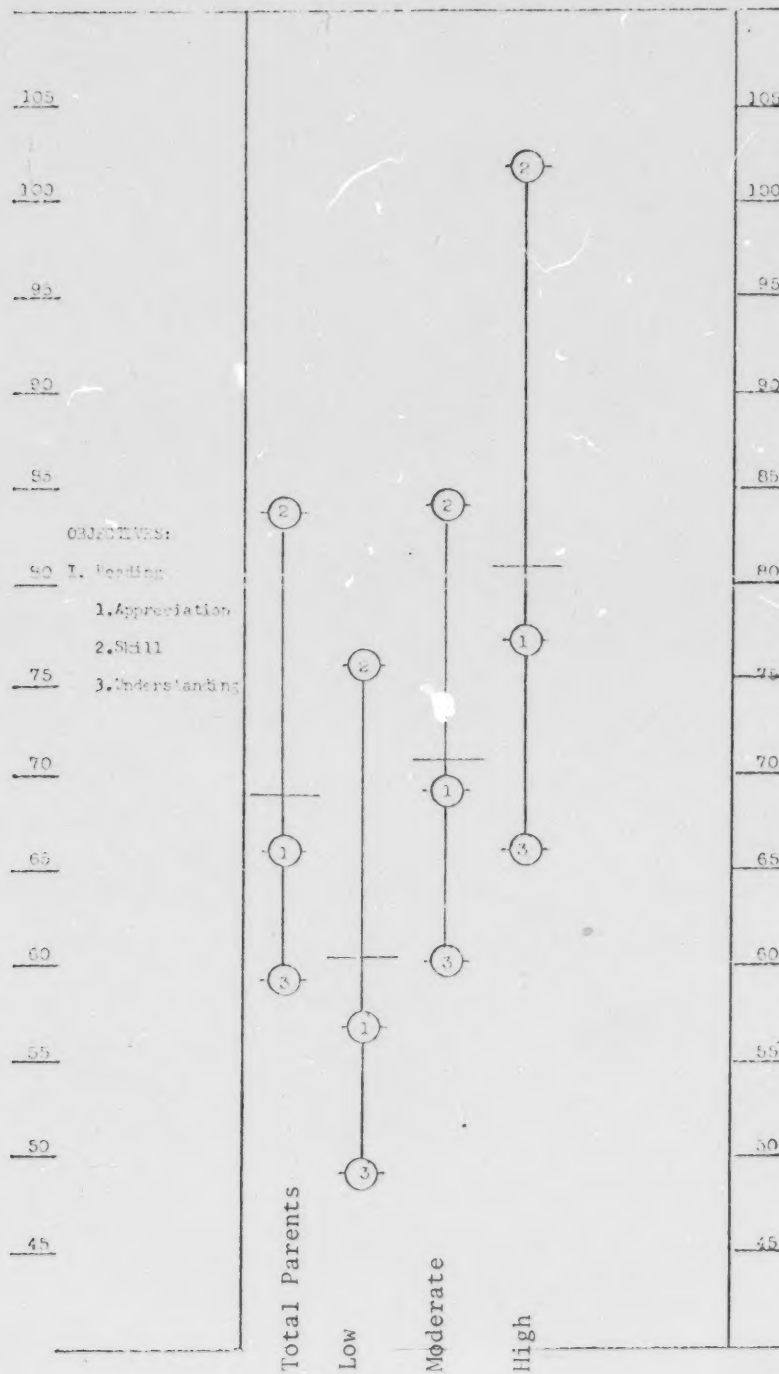


Figure VIII READING OBJECTIVE EVALUATION SCORES

PARENTS GROUPED BY THEIR PERCEPTIONS OF
QUALITY OF EDUCATION AT M _____

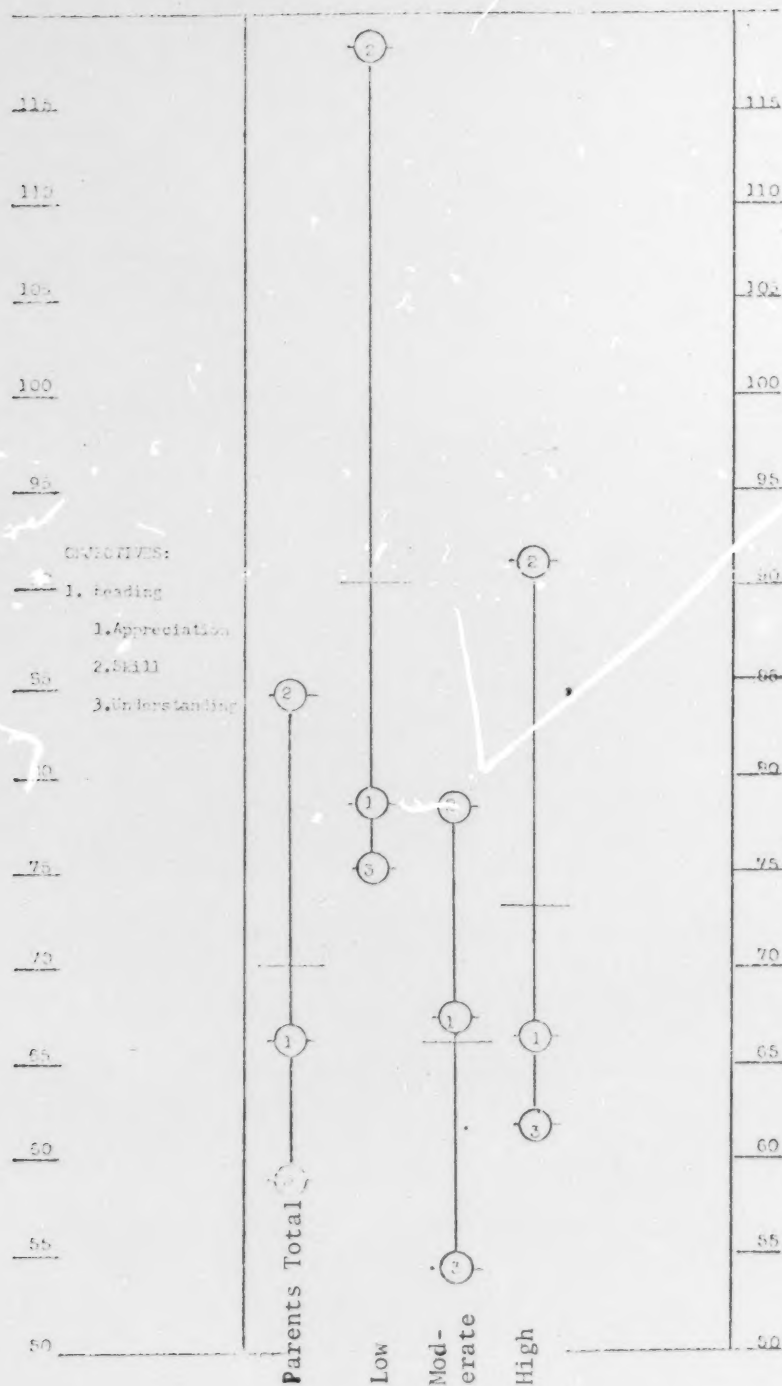
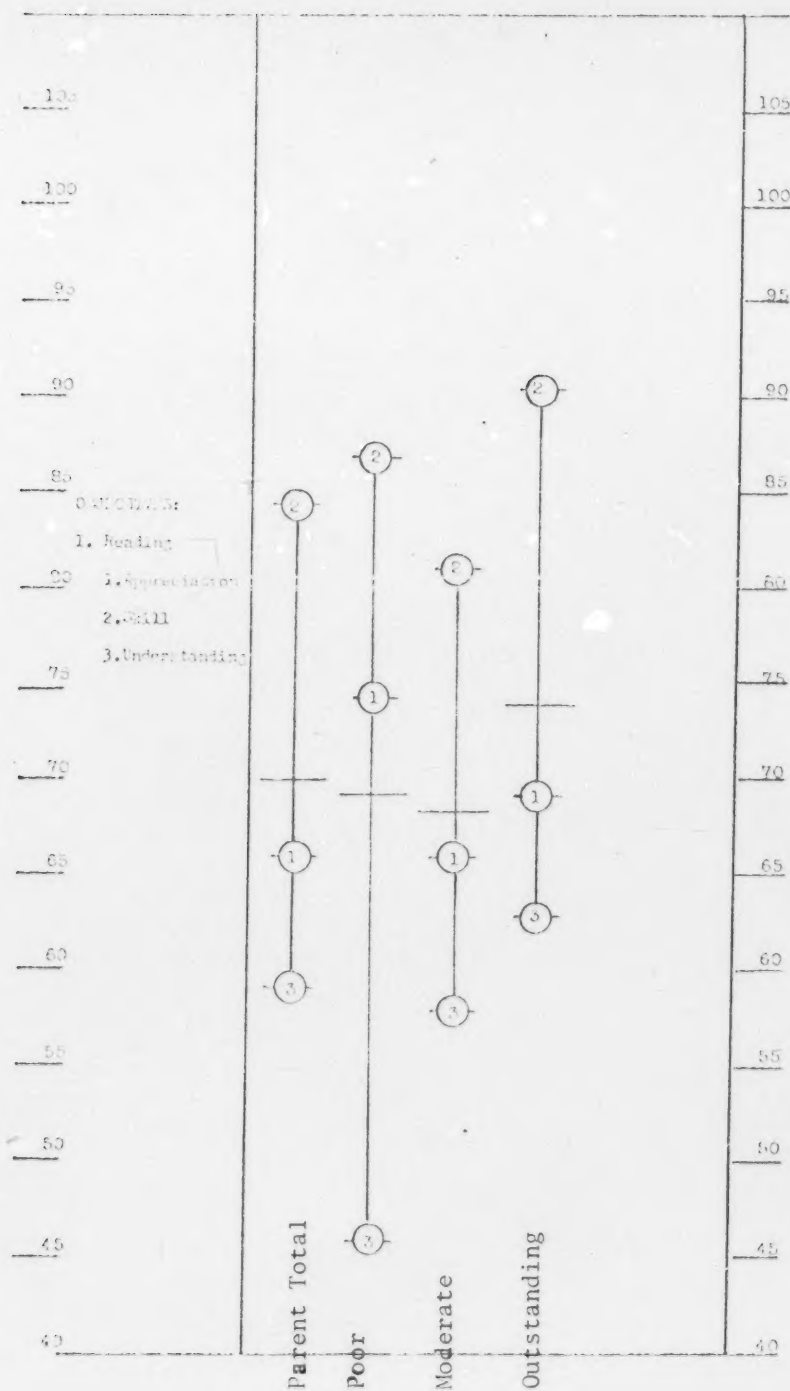


Figure IX. READING OBJECTIVE EVALUATION SCORES
PARENTS GROUPED BY THEIR PERCEPTION OF
ATTITUDE OF CHILDREN



in their twenties) are the only subgroup of parents who valued understanding above appreciation. In general, the following parents tend to rate reading higher than other parent groups: Females (Fig. III), older parents (Fig. IV), parents with some post secondary school (Fig. V), parents with older children in school (Fig. VI), parents active in school affairs (Fig. VII), and parents who are dissatisfied with the quality of education (Fig. VIII). Almost all parent groups except fathers (Fig. III) and people not active in school affairs (Fig. VII) rate reading higher than does the faculty (Fig. III).

I have presented one other figure to illustrate how striking some information may appear. The parents added one objective on drugs to the science group. The behaviors listed were:

Describe some effects and results of drugs such as aspirin, caffeine, alcohol, or tobacco.

Know how to make a decision about when to take medicine and from whom.

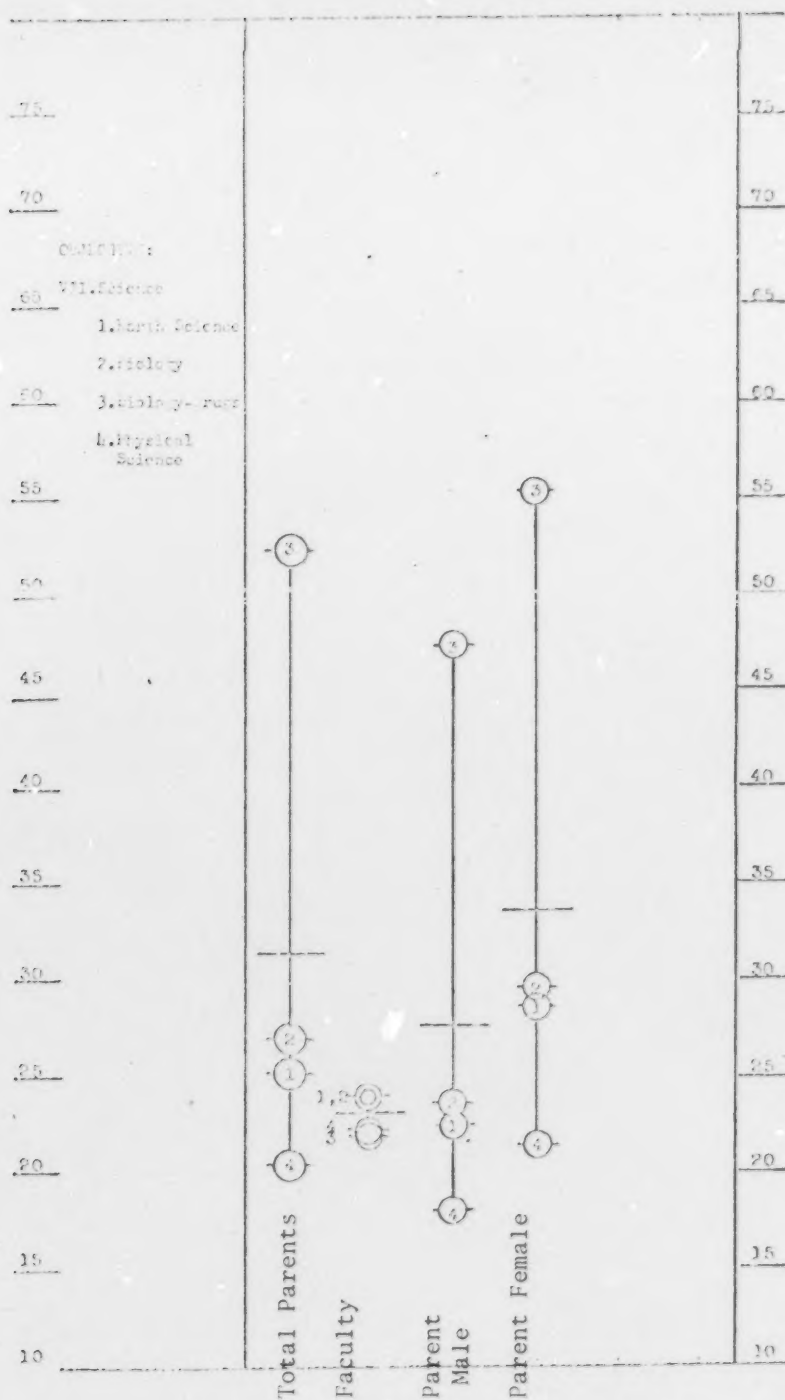
Figure X indicates how parents and faculty responded to all science objectives. The curriculum implications in this information seems self evident.

There are certain relatively consistent response patterns that become evident as the various subgroups in the population are examined. For example, faculty ratings are slightly lower than those for total parents. However, male parents usually gave slightly lower ratings than faculty ratings. Female parent

Figure X

SCIENCE OBJECTIVE EVALUATION SCORES

TOTAL PARENTS, FACULTY, PARENTS-MALE, PARENTS-FEMALE



ratings are substantially higher than male ratings. There were about forty more females than males in the sample. If parent total had been a weighted average of parent-male and parent-female, the faculty and parent total score would have been somewhat closer.

Parent evaluations, when examined by age groups, present a consistent pattern. There is a slight drop in values from the twenties to the thirties followed by a significant rise through the forties and fifties and older age groups.

The trend in objective evaluation scores, as plotted by years of education, presents a confused picture of erratic relationships. In terms of years of education, the score values drop from the eleven years or less category to the twelve years category, then take a significant rise for the thirteen, fourteen, fifteen years category, and drop again for the sixteen, seventeen years of education group. It may be that these groups are confounded by variations in age or sex membership within the groups. The data would permit such an analysis but it has not been undertaken.

Parents with older children in the family rate most objectives higher than do parents with younger children in the family. However, it may be that the difference observed can be accounted for by age difference of the parents.

Parents classified by activity level in school affairs do not present a consistent response pattern across the various objective groupings.

Parents who rate the quality of education as low are small in number but deviate significantly from the rest of the group. Not only do they place about 50% more emphasis on most of the objectives, but in many cases they tend to place the objectives in a different order or relationship. In language arts, they place writing at the top of the language arts objectives, while other groups place writing skills at the bottom of the list. In affective objectives, they place objective #5 (personal temperament) and #4 (achievement motivation) at the top of the list, while other groups assigned these objectives to a more central position.

In cognitive objectives, this group assigned the objectives in a somewhat different order than the rest of the parents. In science, they did not choose to emphasize biology-drugs as did all other parent groups.

In social studies, this same group of parents would place family life in fourth position while all other parent groups selected the top position for family life. One is led to wonder if this group thinks the quality of education is poor simply because their viewpoint on what education should be is so different from the rest of the population.

In general, parents who rate the attitudes of children as poor, tend to place a lower value on most objectives than total parents. By contrast, parents who rate the attitudes as outstanding, tend to assign higher values to the objectives.

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